Application No.: 10/642,758
(80001-2818)

Docket No.: SON-1748/CON

OIPE JAN 09 2006 IAP13 PATENT & TRADEMARK OFFICE

Docket No.: SON-1748/CON
(PATENT)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:

Minoru Hashimoto et al.

Application No.: 10/642,758

Confirmation No.: 3729

Filed: August 19, 2003

Art Unit: 2655

For: OPTICAL DISC DRIVE AND OPTICAL PICKUP APPARATUS THAT CORRECT ASTIGMATISM (As Amended)

Examiner: G. Patel

SUPPLEMENT TO PRELIMINARY REMARKS

AND SUBMISSION OF CERTIFIED TRANSLATION OF PRIORITY DOCUMENTS

MS Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

Supplementing the Preliminary Remarks accompanying the RCE filed on December 12, 2005, we have enclosed Certified English Translations of the two JP Priority Applications H11-047422 filed February 25, 1999 and H11-055410, filed March 3, 1999.

Dated: January 9, 2006

Respectfully submitted,

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICANT : Minoru Hashimoto et al.
APPLICATION No. : 10/642,758 Group Art Unit : 2655
FILING DATE : August 19, 2003 Examiner :G. Patel
TITLE : OPTICAL DISC DRIVE AND OPTICAL PICKUP APPARATUS THAT CORRECT ASTIGMATISM (As Amended)

Hon. Commissioner of Patents and Trademarks,
Washington, D.C. 20231

SIR:

CERTIFIED TRANSLATION

I, Takashi Narita, am an official translator of the Japanese language into the English language and I hereby certify that the attached comprises an accurate translation into English of Japanese Application No. H11-055410, filed on March 3, 1999.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

December 28, 2005

Date

Takashi Narita

Takashi Narita

[Document Name]	Patent Application
[Reference Number]	9801189302
[Filing Date]	March 3, 1999
[To]	Hon.Commissioner, Patent Office
[IPC]	G11B 7/00
[Name of Invention]	Optical Pickup and Optical Disc Drive
[Number of Claims]	10
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[Indication of Charge]	
[Number of Prepaid Ledger]	047267
[Amount]	21,000 yen
[List of Document]	
[Document]	Specification 1
[Document]	Drawing 1
[Document]	Summary 1

[General Power of Attorney Number] 9600452

[Need of Proof] Yes

[Name of Document] SPEFICAITION

[Title of the Invention]

Optical Pickup and Optical Disc Drive

[Claims]

[Claim 1]

An optical pickup adapted to irradiate a laser beam to an optical recording medium, detect a return light from the optical recording medium and providing a result of return light detection, the optical pickup comprising:

first and second light sources to emit the laser beams of different wavelengths, respectively;

a photodetector to detect the return light from the optical recording medium; and

an optical system to converge the laser beam emitted from a selected one of the first and second light sources and guide the return light from the optical recording medium to the photodetector;

the first and second light sources being disposed so that the directions of the deformation, caused by the astigmatism, of the sectional shape of the laser beams emitted from the light sources will nearly coincide with each other; and

the optical system being adapted for common use with the laser beams emitted from the first and second light sources, and including an astigmatism correcting means for common use with the laser beams emitted from the first and

second light sources.

[Claim 2]

The optical pickup as set forth in Claim 1, wherein the astigmatism correcting means is a transparent parallel flat plate.

[Claim 3]

The optical pickup as set forth in Claim 1, wherein the first and second light sources are nearly equal in astigmatism to each other.

[Claim 4]

The optical pickup as set forth in Claim 1, wherein the first and second light sources and the photodetector are provided integrally in one package.

[Claim 5]

An optical disc drive adapted to read information from an optical disc by emitting a laser beam from a selected one of a plurality of light sources disposed apart from each other radially of the optical disc and focusing the laser beam on the optical disc, detecting a return light resulted from reflection of the laser beam at the optical disc and processing the result of return light detection, the optical disc drive including:

first and second light sources to emit the laser beams of different wavelengths, respectively;

a photodetector to detect the return light from the optical recording medium; and

an optical system to converge the laser beam emitted from a selected one of the first and second light sources and guide the return light from the optical recording medium to the photodetector;

the first and second light sources being disposed so that the directions of the deformation, caused by the astigmatism, of the sectional shape of the laser beams emitted from the light sources will nearly coincide with each other; and

the optical system being adapted for common use with the laser beams emitted from the first and second light sources, and including an astigmatism correcting means for common use with the laser beams emitted from the first and second light sources.

[Claim 6]

The optical disc drive as set forth in Claim 5, wherein the astigmatism correcting means is a transparent parallel flat plate.

[Claim 7]

The optical disc drive as set forth in Claim 5, wherein the first and second light sources are nearly equal in astigmatism to each other.

[Claim 8]

The optical disc drive as set forth in Claim 5, wherein the first and second light sources and the photodetector are provided integrally in one package.

[Claim 9]

The optical disc drive as set forth in Claim 5, wherein the photodetector has

the light-incident surface thereof divided in a first direction corresponding to the scanning direction of the laser beam and in a second direction perpendicular to the first direction and thus provides results of light detection from these light-incident surface divisions.

[Claim 10]

The optical disc drive as set forth in Claim 5, wherein the first and second light sources have the deflection surfaces thereof set parallel to the scanning direction of the laser beam or perpendicular to the scanning direction.

[Detailed Description of the Invention]

[0001]

[Technical Field of the Invention]

The present invention relates to an optical pickup and optical disc drive, and more particularly to an optical disc drive adapted to play a digital versatile disc (DVD) and compact disc. The optical disc drive according to the present invention is adapted to correct aberration of a plurality of laser beams by a single astigmatism correcting means and thus the optical disc drive can be simply constructed and operate with an improved optical performance when accessing an optical recording medium with a selected one of a plurality of light sources.

[0002]

[Prior Art]

The conventional optical disc drive or CD player is adapted to irradiate a laser beam from an optical pickup onto an information recording surface of a CD and process a detection result of return light from the CD surface to read or reproduce a variety of data recorded in the CD.

[0003]

The conventional optical pickups include a type having a light-emitting element and light-receiving element disposed separately therein, and a type using an optical integrated device consisting integrally of the light-emitting and -receiving elements. The latter type of optical pickup as a whole can be designed

more compact and have a higher reliability than the former type.

[0004]

In such an optical pickup, a laser diode is disposed for the polarizing plane of a laser beam to be at an angle of about 45 deg. in relation to the scanning direction of the laser beam, and thus it is possible to prevent jitter from being increased due to deterioration of the optical property without any correction of the astigmatism of the laser beam.

[0005]

[Problems to Be Solved by the Invention]

It is considered that using such an optical integrated device to build the optical pickup also in a an optical disc drive for DVD, a so-called DVD player, for example, the DVD player as a whole can conveniently be designed compact and simple. A DVD player will be conveniently usable if it can also read data from a CD.

[0006]

In this case, by forming an optical integrated device integrally from a light-emitting element and light-receiving element for DVD and a light-emitting element and light-receiving element for CD, an optical disc player capable of writing data to both CD and DVD will be possible.

[0007]

As defined in the standard, the pit depth in the compact disc (CD) is one

eighth (λ/8) of the wavelength λ of the laser beam irradiated to the CD, while the pit depth in the DVD is one fourth (λ/4) of the wavelength λ of the laser beam irradiated to the DVD. Thus, in the DVD player, it is difficult to detect a tracking error signal by the similar method to that for CD. Namely, tracking error signal has to be produced by the so-called differential phase detection (DPD) method, for example. In this DPD method, the laser diode as light source has to be disposed in such a manner that the deflection plane of the laser beam will be parallel or perpendicular to the scanning direction of the laser beam.

[0008]

For effective utilization of the internal space of the optical integrated device, the laser diode should desirably be disposed in such a manner that the deflection plane of the laser beam will be parallel or perpendicular to the direction of the optical path of the laser beam.

[0009]

However, when the laser beam deflection plane is directed as in the above, the optical property of a read signal from the optical disc will be deteriorated.

[0010]

It is therefore an object of the present invention to overcome the above-mentioned drawbacks of the prior art by providing an optical pickup simply constructed and having a plurality of light sources selectively used to write data to, and/or read data from, an optical recording medium without any deterioration of

optical property, and an optical disc drive using the optical pickup.

[0011]

[Means to Solve the Problem]

To overcome the above-mentioned drawbacks, in an optical pickup or optical disc derive as set forth in claim 1 or 5, respectively, first and second light sources are disposed for the sections of laser beams emitted the light sources, respectively, to be deformed in an almost same direction due to astigmatism, a single optical system is used in common for the laser beams emitted from the first and second light sources, respectively, and an stigmatism correcting means is provided in common for the laser beams emitted from both the first and second light sources.

[0012]

Since the first and second light sources are disposed for the sections of laser beams emitted the light sources, respectively, to be deformed in an almost same direction due to astigmatism, a single optical system is used in common for the laser beams emitted from the first and second light sources, respectively, and an stigmatism correcting means is provided in common for the laser beams emitted from both the first and second light sources, as defined in claim 1 or 5, the astigmatism correcting means being a simple one can correct the astigmatism of both the laser beams emitted from a plurality of light sources and thus the optical pickup and optical disc drive designed correspondingly simple can operate with an

improved performance.

[0013]

[Preferred Embodiment of the Invention]

The present invention will be described in detail below concerning the embodiment thereof with appropriate reference to the accompanying drawings.

[0014]

(1) Construction of the embodiment

FIG. 1 is a sectional view of the optical system of the optical disc drive as an embodiment of the present invention. The optical disc drive generally indicated with a reference 1 reads data recorded in a DVD as an optical disc 2A, and also data recorded in a compact disc as an optical disc 2B.

[0015]

Note here that the compact disc 2B is an optical disc from which recorded data can be read by processing return light resulted from irradiation of a laser beam to an information recording surface of the disc through a transparent substrate of 1.2 mm in thickness. On the other hand, the optical disc 2A is an optical disc from which recorded data can be read by processing return light resulted from irradiation of a laser beam to an information recording surface of the disc through a transparent substrate of 0.6 mm in thickness.

[0016]

In this optical disc drive 1, an optical pickup 3 is disposed to be movable

radially of the optical disc by a predetermined sled mechanism. The optical pickup 3 consists of an astigmatism correction plate 5, collimator lens 6, aperture 7 and an objective lens 8. A laser beam emitted from an optical integrated device 4 is irradiated to the optical disc 2A or 2B through the astigmatism correction plate 5, collimator lens 6, aperture 7 and objective lens 8. On the contrary, a return light from the optical disc 2A or 2B is incident upon the optical integrated device 4 through the objective lens 8, aperture 7, collimator lens 6 and astigmatism correction plate 5.

[0017]

The optical disc drive 1 processes a result of the detection of the return light by the optical integrated device 4 to produce a tracking error signal, focus error signal and a read signal. The optical disc drive 1 moves the objective lens 8 based on the tracking and focus error signals to control the tracking and focus, and processes the read signal to reproduce data recorded in the optical disc 2A or 2B.

[0018]

The optical integrated device 4 is formed from a light-emitting element and light-receiving element for CD and a light -emitting element and light-receiving element for DVD, both integrally disposed in a package. The optical integrated device 4 has two semiconductor laser diode chips forming the light-emitting elements, respectively, disposed about 100 μm apart from each other radially of the optical disc 2A or 2B. These semiconductor laser diode chips are selectively

driven under the control of a system controller (not show) depending upon which is currently used, the optical disc 2A or 2B. Thus, the optical integrated device 4 selectively emits a laser beam of a wavelength corresponding to the optical disc 2A or 2B towards the optical disc 2A or 2B, and return light from the optical disc 2A or 2B is detected by a corresponding light-receiving element.

[0019]

The astigmatism correction plate 5 is a transparent parallel flat plate and it is disposed in the optical path of the laser beam and obliquely in relation to the optical axis of the laser beam. The astigmatism correction plate 5 is equal in astigmatism to the laser beam. Its gradient, thickness, etc. are selected to provide an astigmatism which will cancel that of the laser beam. Thus, the astigmatism correction plate 5 corrects the astigmatism of each of laser beams different in wavelength from each other.

[0020]

The collimator lens 6 converts the laser beam having passed through the astigmatism correction plate 5 into a generally parallel beam for projection.

[0021]

The aperture 7 is a transparent plate with a dielectric layer evaporated thereon and a circular opening formed in the center thereof. Namely, the aperture 7 has the dielectric layer around the central opening formed therein. The dielectric layer serves as a filter to selectively intercept a laser beam of 780 nm in

wavelength for CD while allowing a laser light of 650 nm in wavelength for DVD to penetrate through it. Thus, the aperture 7 will shape the incident laser beam for CD to be a beam having a diameter depending upon the diameter of the opening, while allowing the laser beam for DVD to pass through the aperture 7 with the shape thereof not changed at all. Note that the aperture 7 is so disposed that the center of the opening formed therein will nearly coincide with the optical axis of the CD laser beam.

[0022]

The objective lens 8 is an aspheric plastic lens formed from a transparent resin by injecting molding. By selecting an appropriate refractive index of the transparent resin and shape of the lens surface, the objective lens 8 is formed to focus the incident parallel laser beam for DVD or CD onto the information recording surface of the optical disc 2A or 2B. Thus, the objective lens 8 is formed as a so-called bifocal lens for both the laser beams for DVD and CD, respectively.

[0023]

Further, the objective lens 8 is movable by a tracking control actuator composed of a voice-coil motor radially of the optical disc 2A or 2B so that tracking control can be done by driving the actuator correspondingly to a tracking error signal. Also, the objective lens 8 is movable by a similar focus control actuator along the optical axis of the laser beam so that focus control can be done

by driving the focus control actuator correspondingly to a focus error signal.

[0024]

When reading the optical disc 2B, the objective lens 8 is moved by the tracking control actuator 8 radially of the optical disc 2B correspondingly to the spacing between the light sources in the optical integrated device 4, whereby the optical property of the optical system is prevented from being deteriorated when reading the optical disc 2B.

[0025]

A matrix calculation circuit 9 is also provided to made matrix calculation of a result of the light detection output from the optical integrated device 4 to produce a tracking error signal TE whose level varies depending upon the magnitude of a tracking error, focus error signal FE whose level varies depending upon the magnitude of a focus error, and a read signal whose level varies depending upon the pit train. The matrix calculation circuit 9 produces a tracking error signal, focus error signal and read signal for each of DVD and CD.

[0026]

FIG. 2A is a plan view, from the emitted direction of the laser beam, of the optical integrated device 4, and FIG. 2B is a sectional view, taken along the direction tangential to the circumference of the optical disc 2A or 2B, of the optical integrated device 4. The optical integrated device 4 is constructed by disposing a prism 14 and semiconductor laser diode chips 15A and 15B on a semiconductor

substrate 17 to form an optical system 16, putting the optical system 16 in a package 18 and wiring it, and then sealing the package 18 with a transparent glass 19.

[0027]

The semiconductor laser diode chips 15A and 15B are disposed apart by about 100 μm from each other radially of the optical disc 2A or 2B and emit a laser beam having a wavelength of 650 nm for DVD and a laser beam having a wavelength 780 nm for CD, respectively, towards the prism 14. Also, the semiconductor laser diode chips 15A and 15B are disposed for the deflection plane to be parallel or perpendicular to the scanning direction of the laser in the light-incident surface of the optical disc 2A or 2B. Further, the semiconductor laser diode chips 15A and 15B in pair are nearly equal in astigmatism to each other. They are disposed so that the section of the laser beam will be deformed by the astigmatism in the same direction. Thus, in the optical disc drive 1, the single astigmatism correction plate 5 corrects the astigmatism of each of the laser beams emitted from the two light sources. When reading a DVD, a tracking error signal can be detected by the DPD (differential phase detection) method.

[0028]

The prism 14 is an optical element provided to separate the laser beam and return light from each other and it is formed to have a generally rectangular shape having a slope at one lateral side thereof. Thus, a laser beam emitted from the

semiconductor laser diode chip 15A or 15B is reflected at the slope of the prism 14 towards the collimator lens 5, and return light having traveled reversely along the optical path of the laser beam and incident upon the prism 14 is guided inwardly of this slope.

[0029]

At the prism 14, the return light incident upon the slope is incident upon the bottom of the prim 14. About 50% of the return light is penetrated through the prism bottom while the remainder is reflected towards the top of the prism 14. The return light incident upon the prism top is reflected nearly 100% there towards the prism bottom and allowed to outgo through the prism bottom.

[0030]

The prism 14 has a mirror surface formed on a portion of the bottom thereof at the slope side (will be referred to as "front side" hereinafter) and a beam splitting surface and light-transmissive surface formed on a portion of the bottom thereof at the side away from the slope (will be referred to as "rear side" hereinafter) so that the ratio in amount between the return light allowed to outgo through the prism bottom at the front-side portion and that allowed to outgo through the prism bottom at the rear-side portion will be nearly 1 : 1. The beam splitting surface and light-transmissive surface are formed by the similar evaporation to that used in forming the mirror surface.

[0031]

The semiconductor substrate 17 has light-incident surfaces 25A and 26A for DVD and light-incident surfaces 25B and 26B for CD formed on portions, respectively, thereof upon which the return portion of the laser beam for DVD and that of the laser beam for CD are incident from the prism 14.

[0032]

FIG. 3 is a plan view, partially enlarged in scale, of the light detection systems for CD and DVD, respectively, formed from the above-mentioned light-incident surfaces of the optical integrated device 4. For the optical integrated device 4, the directions of the semiconductor laser diode chips 15A and 15B and size of the prism 14 are selected so that when the laser beam is just focused, a beam spot defined on the semiconductor substrate 17 by the return light having passed through the prism 14 will be formed, at the rear-side portion, like a focal line, and at the front-side portion, like an ellipse having the major axis thereof directed perpendicularly to the extension of the focal line at the rear-side portion.

[0033]

The light-incident surfaces 25B and 26B for CD are formed side by side tangentially to the circumference of CD to have a general shape of a rectangle, and each is divided radially of CD by a parting line extending tangentially to the circumference of CD. Thus, when the optical head is just on an intended track on a CD, each of the light-incident surfaces 25B and 26B can detect a beam spot defined thereon and quartered radially of CD. Namely, a result of light detection

by each of the quartered light-incident surfaces is provided as output. In FIG. 4, the outer light-incident surface divisions at the front-side portion are indicated with references *m* and *p*, respectively, while the inner ones are indicated with references *n* and *o*, respectively. The outer light-incident surface divisions at the rear-side portion are indicated with references *q* and *t*, respectively, while the inner ones are indicated with references *r* and *s*, respectively.

[0034]

The light-incident surfaces 25A and 26A for DVD are formed side by side tangentially to the circumference of the optical disc 2A in the similar manner to that for the light-incident surfaces 25B and 26B to have a general shape of a rectangle. The light-incident surface 26A at the rear-side portion is formed similarly to the light-incident surface 26B at the rear-side portion for CD.

[0035]

The light-incident surface 25A at the front-side portion is formed similarly to the light-incident surface 25B at the front-side portion for CD, and further it is divided by two tangentially to the circumference of the optical disc. Thus, the semiconductor substrate 17 can produce a tracking error signal by the so-called differential phase detection (DPD). As shown in FIG. 4, the outer and on-slope light-incident surface divisions for DVD at the front-side portion are indicated with references *a* and *d*, respectively, and the inner and under-slope light-incident surface divisions at the front-side portion are indicated with references *b* and *c*,

respectively. Further, the outer and off-slope light-incident surface divisions at the front-side portion are indicated with references *e* and *h*, respectively, and the inner and off-slope light-incident surface divisions at the front-side portion are indicated with references *f* and *g*, respectively. Also, the outer light-incident surface divisions at the rear-side portion are indicated with references *i* and *l*, respectively, and the inner light-incident surface divisions at the rear-side portion are indicated with references *j* and *k*, respectively.

[0036]

The semiconductor substrate 17 converts the results of light detection from the light-incident surface divisions *a* to *t* from current to voltage, then calculates the converted signals and provide the results of calculation to the matrix calculation circuit 9 where the calculated signals will further be calculated to produce a tracking error signal, focus error signal and a read signal.

[0037]

When reading a CD, the results of light detection are processed as follows. Differences in light detection are detected between the inner and outer light-incident surface divisions of each of the front- and rear-side light-incident surfaces 25B and 26B, and then a subtraction between the differences is made between the front- and rear-side light surfaces 25B and 26B to produce a focus error signal expressed by $(m + p + r + s) - (n + o + q + t)$. Differences in light detection are detected between the inner and outer circumferential light-incident

surface divisions of each of the front- and rear-side light-incident surfaces 25B and 26B, and then a subtraction between the differences is made between the front- and rear-side light surfaces 25B and 26B to produce a tracking error signal expressed by $(m + n + s + t) - (o + p + q + r)$. Then all the results of light detection at the front- and rear-side light-incident surfaces 25B and 26B are added together to produce a read signal expressed by $(m + n + o + p + q + r + s + t)$.

[0038]

When reading a DVD, the results of light detection are processed in the same manner as in the above for reading a CD to produce a focus error signal expressed by $(a + b + e + h + j + k) - (b + c + f + g + i + l)$ and a read signal expressed by $(a + b + c + d + e + f + g + h + i + j + k + l)$. On the other hand, for production of the tracking error signal TE for DVD, results of light detection are processed as follows. As shown in FIG. 4, results of light detection from two light-incident surfaces corresponding to the inner and outer circumferences of the optical disc 2A are added together by addition circuits 42A to 42D for each of the groups of light-incident surface divisions defined in the direction of the light-incident surfaces 25A and 26A disposed side by side. Thus quantities of light incident upon the inner and outer circumferential-side light-incident surface divisions are determined for each group. For each of the groups, results of light detection are compared in phase between the groups of the inner and outer circumferential-side light-incident surface divisions by phase comparison circuits

43A and 43B, and then added together by an addition circuit 44 to produce a tracking error signal TE.

[0039]

(3) Operation of the embodiment

In the optical disc drive 1 constructed as having been described in the foregoing with reference to FIG. 1, the optical pickup 3 irradiates a laser beam to the optical disc 2A or 2B and detects return light from the optical disc, and a selected one of the signal processing circuits processes the result of return light detection, thereby reading information from the optical disc 2A or 2B.

[0040]

More particularly, a laser beam is emitted from the optical integrated device 4 of the optical pickup 3 incorporated in the optical disc drive 1, converted to a nearly parallel beam by the collimator lens 6, passed through the aperture 7, and guided to the objective lens 8 which will focus the laser beam on an information recording surface of the optical disc 2A or 2B. Return light resulted from reflection of the laser beam at the information recording surface is passed through the objective lens 8 and incident upon the optical integrated device 4 which provides results of return light detection as outputs.

[0041]

In the optical disc drive 1, the tracking error signal TE is produced by processing the results of return light detection as in the above, and the objective

lens 7 is moved by the servo circuit radially of the optical disc 2A or 2B until the tracking error signal TE gets a predetermined signal level. Namely, a tracking control is made. Similarly, a focus error signal is produced, and the objective lens 7 is moved up and down until the focus error signal has a predetermined level. This is the focus control according to the present invention.

[0042]

That is, when the optical disc (2A or 2B) loaded in the optical disc drive 1 is a DVD (namely, 2A), one of the semiconductor laser diode chips 15A and 15B disposed side by side in the optical integrated device 4 radially of the optical disc 2A or 2B (see FIG. 3), that is, the semiconductor laser diode chip 15A, is selected to emit a laser beam towards the optical disc 2A, and return light from the optical disc 2A is detected by the light-incident surfaces 25A and 26A for DVD via the prism 14.

[0043]

On the other hand, when the optical disc loaded in the optical disc drive 1 is CD (namely, 2B), the semiconductor laser diode chip 15B (see FIG. 3) is selected to emit a laser beam towards the optical disc 2B, and return light from the optical disc 2B is detected by the light-incident surfaces 25B and 26B for CD via the prism 14.

[0044]

Further, the result of light detection is processed by the matrix calculation

circuit 9 to generate a read signal RF, tracking error signal TE and focus error signal FE for each of the CD and DVD.

[0045]

In the optical disc drive 1 according to the present invention, the astigmatism correction plate 5 made of a transparent parallel flat plate is disposed obliquely in the optical path of the laser beam to correct the astigmatism of the laser beam emitted from a selected one of the light sources in reading the optical disc 2A or 2B.

[0046]

For the astigmatism correction, there is disposed in the optical disc drive 1 the pair of the semiconductor laser diode chips 15A and 15B nearly equal in astigmatism to each other in such a manner that the deflection plane on the disc surface is parallel or perpendicular to the scanning direction of the laser beam and the sections of the laser beams are deformed in a nearly same direction by the astigmatism. Therefore, the single astigmatism correction plate 5 can be used in common with the two laser beams to correct the astigmatism of each of the laser beams. Thus, the simple design of the optical disc drive 1 improves the optical property.

[0047]

As mentioned above, the semiconductor laser diode chips 15A and 15B can be disposed in the optical disc drive 1 for the laser beam deflection plane to be

parallel or perpendicular to the scanning direction of the laser beam, and the tracking error signal for DVD can be produced by the DPD method. Also, since the internal space of the optical integrated device 4 can effectively be utilized to enable a compact design of the optical integrated device 4.

[0048]

(3) Effect of the embodiment

Owing to the above-mentioned construction of the optical disc drive 1, a laser beam can be emitted from a selected one of the semiconductor laser diode chips disposed apart from each other radially of the optical disc, and focused on the optical disc via the common optical system. In this light generation and guiding, the single astigmatism correcting means can be used to correct the aberration of the laser beam. Thus, the simple design of the optical disc drive 1 will lead to an improvement of the optical property.

[0049]

(4) Other possible embodiments

The present invention has been described in the foregoing concerning the embodiment in which the transparent parallel flat plate is used as the astigmatism correcting means. However, the present invention is not limited to this embodiment, but the astigmatism may be formed from a cylindrical lens, hologram, Fresnel lens or the like. When a coupling lens is used, the astigmatism correcting means may be formed on the coupling lens.

[0050]

Note that although it was described in the foregoing that the objective lens is moved in conjunction with the selection of a laser beam source, the present invention is not limited to this embodiment, the entire optical system may be adapted to be movable. The optical system may be adapted not to be movable if only a practically satisfactory performance can be assured.

[0051]

In the foregoing, the present invention has been described concerning the embodiment in which light-incident surfaces are formed in the optical system for each of the types of optical discs DVD and CD. However, the present invention is not limited to this embodiment but the light-incident surface may be formed commonly to both the DVD and CD.

[0052]

The present invention has been described in the foregoing concerning the embodiment adapted to be compatible with both a CD and DVD. However, the present invention is not limited to this embodiment, but can be adapted to be compatible with both a CD and a recordable compact disc such as CD-R.

[0053]

The present invention has been described concerning the embodiment in which two different types of optical disc are read by the single optical pickup. However, the present invention is not limited to this embodiment, but can widely

be adapted to read more than two types of optical disc.

[0054]

The present invention has been described in the foregoing as to the embodiment in which the optical pickup is constructed from the optical integrated device formed integrally from a light-emitting element and light-receiving element. However, the present invention is not limited to this embodiment, but it can be adapted such that the light-emitting and -receiving elements are disposed separately from each other.

[0055]

[Effect of the Invention]

As having been described in the foregoing, according to the present invention, the single astigmatism correcting means is used to correct the aberration of more than one laser beams, so that a simple construction of the optical disc drive assures an improved optical property when a plurality of light sources is selectively used to read an optical recording media.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a sectional view of the optical disc drive according to the present invention;

FIG. 2 is a plan/sectional view of an optical integrated device used in the optical disc drive in FIG. 1;

FIG. 3 is a plan view of the light-incident surface of the optical integrated device included in the optical pickup in FIG. 2

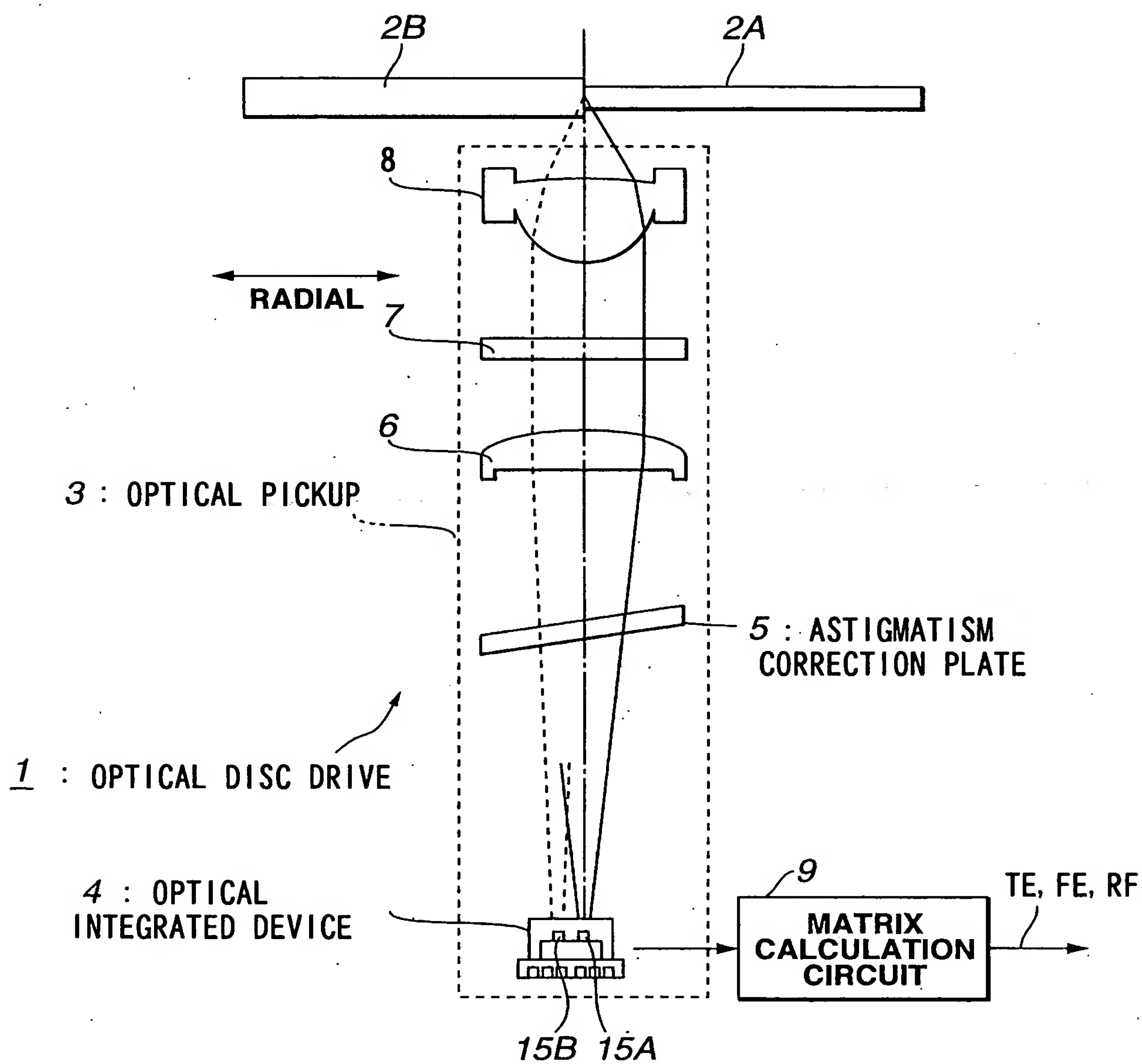
FIG. 4 is a block diagram explaining the generation of a tracking error signal by the optical integrated device in FIG. 2.

[Explanation of Referenced Numerals]

1 ... Optical disc drive, 2A ... DVD, 2B ... CD, 3 ... Optical pickup, 4 ... Optical integrated device, 5 ...Astigmatism correction plate, 5 ... Collimator lens, 6 ... Aperture, 7 ... Objective lens, 14 ... Prism, 15A, 15B ... Semiconductor laser diode chip, 25A, 25B, 26A, 26B ... Light-incident surface

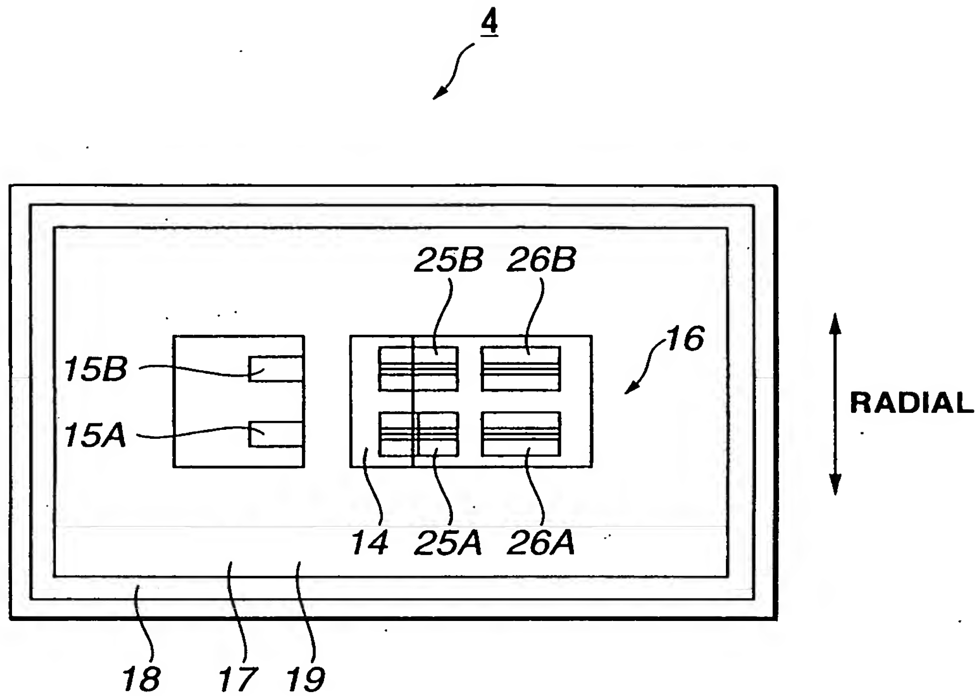
[DOCUMENT NAME] DRAWING

[FIG.1]

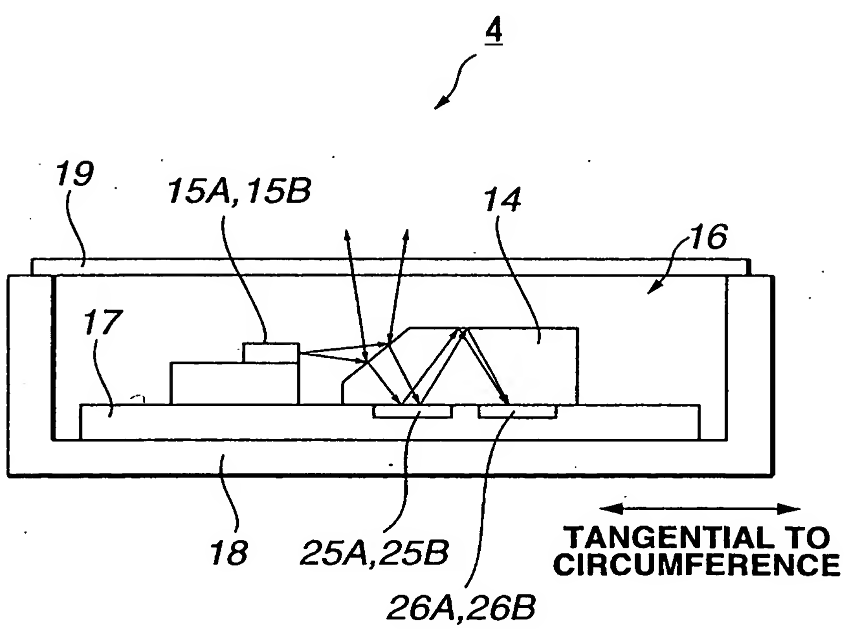


[FIG.2]

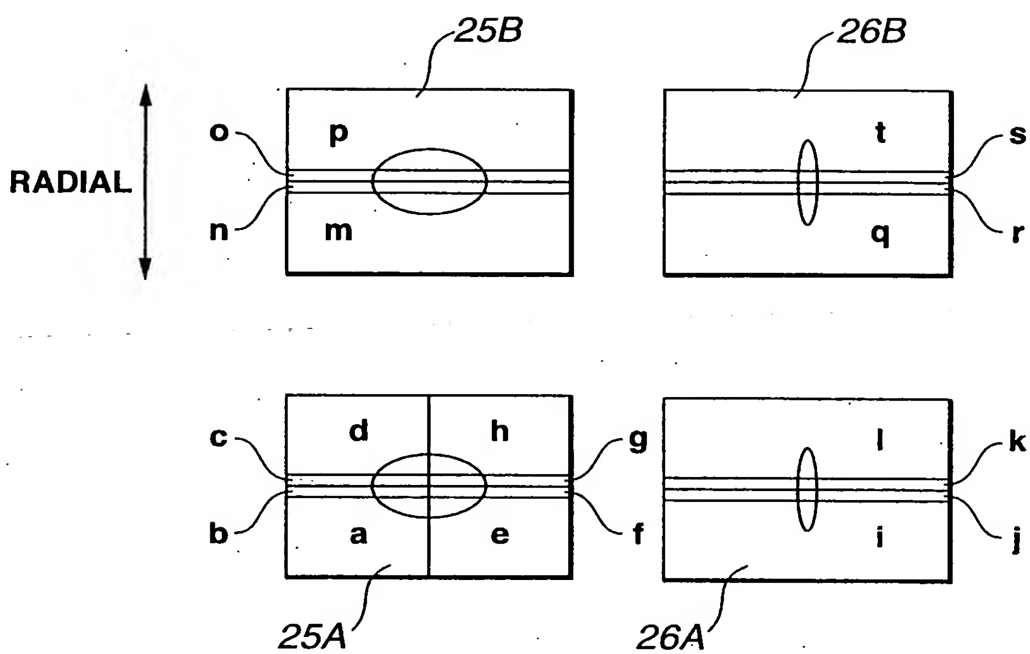
(A)


4
25B
26B
16
15B
15A
14
25A
26A
18
17
19
RADIAL

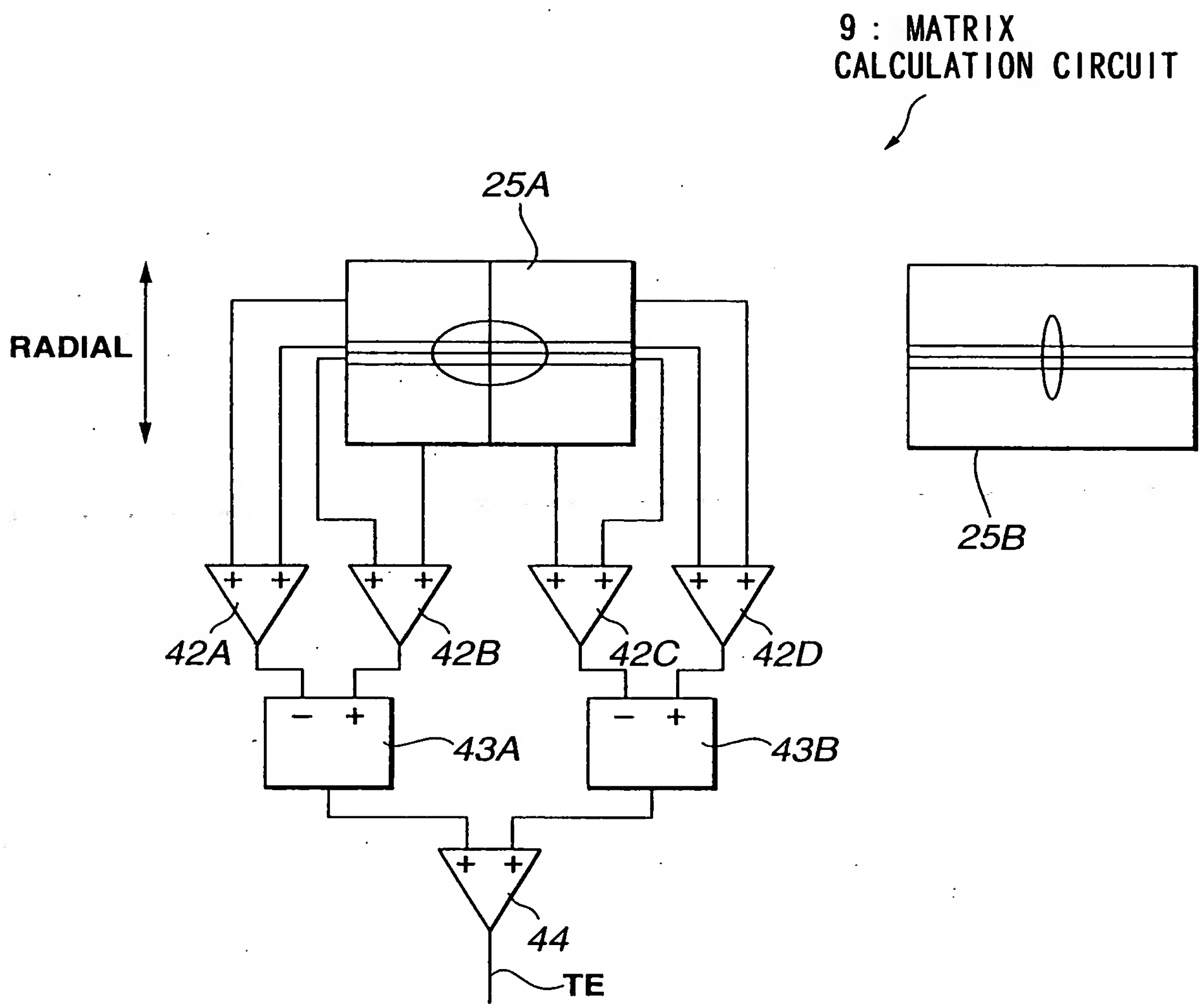
(B)


4
19
15A,15B
14
16
17
18
25A,25B
26A,26B
TANGENTIAL TO
CIRCUMFERENCE

[FIG.3]



[FIG.4]



9 : MATRIX
CALCULATION CIRCUIT
25A
RADIAL
25B
42A
42B
42C
42D
43A
43B
44
TE

[Name of Document] ABSTRACT

[Summary]

[Task]

The present invention relates to an optical pickup and optical disc drive. It is applied to an optical disc drive compatible with optical discs of different types, for example, a DVD and compact disc. The optical disc drive designed simple can operate with an improved optical property.

[Means for Solution]

A single astigmatism correction plate (5) is used to correct aberration of a plurality of laser beams.

[Selected Drawing] FIG. 1